AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A method of determining a time of flight of a signal transmitted between a transmitter and a receiver, said method comprising the steps of:

at a signal transducer of the transmitter, generating a first ultrasonic signal comprising ~~at least one~~ a plurality of cycles of a characteristic waveform feature;

at the signal transducer of the transmitter, generating a second ultrasonic signal comprising ~~at least one~~ a plurality of cycles of the ~~corresponding~~ characteristic waveform feature and further comprising a waveform modification being a phase shift in the cycle of a characteristic waveform feature introduced at a predetermined point in time of ~~the~~ a duration of the second ultrasonic signal;

receiving said first and second generated signals at the receiver;

determining a time of reception of the introduced ~~waveform feature modification~~ phase shift in the second ultrasonic signal by comparing the waveform of the first received signal to the waveform of the second ultrasonic signals and determining a point of diversion between corresponding characteristic waveform features of the first and second received signals ~~comprising super-positioning said first and second received signals~~;

determining a time of flight of the ~~introduced waveform modification~~ second ultrasonic signal based on the determined time of reception of the introduced ~~waveform feature~~ phase shift and its time of generation.

2. (currently amended): The method of claim 1 wherein the step of determining a point of diversion further comprises:

calculating ~~the~~ a difference between a value of the first received signal and a corresponding value of the second received signal at each point of occurrence of a characteristic waveform feature within the first received signal;

designating the point of diversion as the first point of occurrence at which the calculated difference is greater than the value of the second received signal.

3. (currently amended): The method of claim 2 further comprising the step of:

calculating the difference between the time of the point of diversion and the time of generation of the introduced ~~waveform feature~~phase shift ~~modification~~.

4. (currently amended): The method of claim 2 further comprising the steps of:

measuring a time relationship between ~~a nominated characteristic waveform feature~~the introduced phase shift and the point of diversion and;

calculating the difference between the time of reception, based on the measured time relationship, and the time of generation of the ~~nominated characteristic waveform feature~~introduced phase shift.

5. (cancelled).

6. (previously presented): The method of claim 1 further comprising the step of:

repeating the steps of generating and receiving such that successive first and second ultrasonic signals are super positioned at the step of determining.

7. (previously presented): The method of claim 1, wherein the characteristic waveform feature of a signal is one of:

a) a peak;

b) a combination of peaks;

c) a zero-crossing;

d) a combination of zero-crossings.

8. (currently amended): The method of claim 1, wherein the ~~waveform modification~~phase shift is introduced near the start of ~~a~~ the second ultrasonic signal.

9. (currently amended): The method of claim 8 wherein the ~~waveform modification~~phase shift is introduced at one of ~~the~~ a third, fourth or fifth waveform peak after the ~~onset~~ start of ~~a signal~~the second ultrasonic signal.

10. (currently amended): The method of claim 1, wherein the ~~waveform modification~~phase shift comprises a phase inversion.

11. (canceled).

12. (currently amended): The method of claim 1, wherein the ~~ultrasonic signals are provided by~~ signal transducers of the transmitter is driven at a resonant ~~frequencies~~ frequency in a frequency range of about 60 kHz to about 90 kHz.

13. (previously presented): Apparatus adapted to determine the time of flight of a signal transmitted between a transmitter and a receiver, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set,

said apparatus, in conjunction with said instruction set, being adapted to perform the method of claim 1.

14. (currently amended): A method of determining a time of flight of a signal transmitted between a transmitter and a receiver, said method comprising the steps of:

generating at a transducer or the transmitter a first and a second ultrasonic signal, where both signals comprise plurality of cycles of ~~at least one~~ a characteristic waveform feature, and the second ultrasonic signal further comprises a waveform modification introduced at a predetermined point in time of the duration of the second ultrasonic signal, and said waveform modification comprises a phase shift in a cycle of the characteristic waveform feature;

receiving said first and second generated signals at the receiver;

scanning through said the first received signal and the second received signal in time to determine a point of diversion between ~~a~~ the characteristic waveform features of the first received signal and ~~a~~ the corresponding characteristic waveform feature of the second received

signal~~s~~, wherein said point of diversion corresponds to a time of reception of the introduced waveform ~~feature~~ modification at the receiver;

determining the time of flight of the ~~introduced waveform feature~~second ultrasonic signal on the basis of the time of reception of the introduced waveform ~~feature~~ and its time of introduction into the second ultrasonic signal.

15. (currently amended): The method of claim 14 further comprising the steps of:

for each characteristic waveform feature ~~of~~received in the first received signal, calculating ~~the~~ a difference between a value of the first received signal and a temporally corresponding value of the second received signal;

designating the first point ~~of occurrence~~ at which the calculated difference is greater than the value of the second received signal as a point of diversion.

16. (currently amended): The method of claim 15 further comprising the step of:

calculating the difference between the time of the point of diversion and the time of generation of the introduced ~~waveform feature modification~~phase shift.

17. (currently amended): The method of claim 15 further comprising the step of:

measuring a time relationship between ~~a nominated characteristic waveform feature~~an introduced phase shift and the point of diversion and calculating the difference between the time of reception, based on the measured time relationship, and the time of generation of the ~~nominated characteristic waveform feature~~introduced phase shift.

18-19 (cancelled).

20. (previously presented): Apparatus adapted to determine the time of flight of a signal transmitted between a transmitter and a receiver, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set, said apparatus, in conjunction with said instruction set, being adapted to perform the method of claim 14.

21. (currently amended): The method of claim 1 further comprising the steps of:

selecting a characteristic waveform feature of ~~a~~ the first ultrasonic signal in accordance with predetermined selection criteria based on the point of diversion;

generating and receiving a plurality of first ultrasonic signals;

detecting zero-crossings of the received plurality of first ultrasonic signals which indicate the presence of the selected characteristic waveform feature in each of the received plurality of first ultrasonic signals;

estimating a position of the selected characteristic waveform feature of the received plurality of first ultrasonic signals in accordance with predetermined estimation criteria based on the detected zero crossings to provide a position estimation value;

processing the position estimation value to determine a corresponding estimation time;

calculating the time of arrival of the selected characteristic waveform feature of at least one of the received plurality of first ultrasonic signals by adding a predetermined delay time to the estimation time.

22. (original): The method of claim 21 wherein the predetermined selection criteria comprise one of:

a) adding a predefined delay to the time of the point of diversion;

b) subtracting a predefined delay from the time of the point of diversion.

23. (previously presented): The method of claim 21 wherein the predetermined estimation criteria comprise:

a) measuring the time of zero-crossings adjacent the selected characteristic waveform feature and;

b) averaging the measured time of zero-crossings.

24. (currently amended): Apparatus adapted to determine the time of flight of a signal transmitted between a transmitter and a receiver, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set, said apparatus, in conjunction with said instruction set, being adapted to perform the method of claim 21 wherein said apparatus comprises:

a signal ~~transducing~~ transducer~~means for~~ generating and receiving a plurality of first ultrasonic signals;

waveform feature selection means operatively connected to the signal ~~transducing~~ transducer~~means~~ and the processor means for selecting a characteristic waveform feature of ~~a~~ the first ultrasonic signal in accordance with predetermined selection criteria based on the point of diversion;

zero-crossing detection means operatively connected to the ~~transducing~~ transducer ~~means~~ and the processor means for detecting zero-crossings of the received plurality of first ultrasonic signals which indicate the presence of the selected characteristic waveform feature in each of the received plurality of first ultrasonic signals;

signal position estimation means operatively connected to the zero-crossing detection means and the processor means for estimating a position of the selected characteristic waveform feature of the plurality of received first ultrasonic signals in accordance with predetermined estimation criteria based on the detected zero-crossings to provide a position estimation value;

wherein the processor means processes the position estimation value to determine a corresponding estimation time and calculates the time of arrival of the selected characteristic waveform feature of at least one of the plurality of received first ultrasonic signals by adding a predetermined delay time to the estimation time.

25. (original): The apparatus of claim 24 wherein said signal position estimation means comprises a dual slope integrator.

26. (previously presented): The apparatus of claim 24 wherein said plurality of received first ultrasonic signals are digitised and said processor means comprises digital data processing means comprising said zero-crossing detection means and said signal position estimation means.

27. (currently amended): A method of monitoring flow through a particle detector of an aspirated smoke detector system, <u>the aspirated smoke detector comprising a flow path along which air is drawn, and a flow sensor including a first transducer and a second transducer arranged to detect flow in the flow path,</u> the method comprising the steps of:

~~ascertaining the base flow of fluid through a particle detector using a flow sensor;~~

~~monitoring subsequent flow through the particle detector;~~

<u>measuring a transit time (t_1) of a forward signal, transmitted from the first transducer in a forward direction, being generally in the direction of flow along the flow path, to the second transducer, the transit time (t_1) being measured using a method as claimed in claim 1;</u>

<u>measuring a second transit time (t_2) of a return signal, transmitted from the second transducer in a return direction, being generally opposite the direction of flow along the flow path, to the first transducer, the transit time (t_2) being measured using a method as claimed in claim 1;</u>

~~comparing the subsequent flow with the base flow, and indicating a fault if the difference between the base flow and the subsequent flow exceeds a predetermined threshold wherein base flow and subsequent flow are determined at respective times according to the following general flow calculation:~~

<u>determining a volumetric flow rate, f, in the flow path using the general flow calculation:</u>

f = S x A

where ~~f = volumetric flow;~~

A = cross sectional area of an air flow path through the detector system;

s = speed of air through the detector system such that s is given by;

$$s = \frac{d}{2}\left(\frac{1}{t_2} - \frac{1}{t_1}\right)$$

~~where t_2 is the transit time of a signal transmitted in a forward direction, being generally in the direction of flow, from a first transducer located adjacent the flow path to a second transducer located generally opposite the first transducer and adjacent the flow path;~~

~~t_2 is the transit time of a signal transmitted in a reverse direction, being generally against the direction of flow, from the second transducer to the first transducer;~~

<u>and</u> d is a distance travelled by the signal between the first and second transducer;

and wherein both t_1 and t_2 are determined in accordance with the method of claim 1.

28. (original): Apparatus adapted to monitor flow through a particle detector of an aspirated smoke detector system, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set,

said apparatus, in conjunction with said instruction set, being adapted to perform the method of claim 27.

29. (currently amended): A method of detecting one or more blocked sampling holes in a pipe of an aspirated smoke detector system, said aspirated smoke detector system comprising a sampling network including one or more sampling holes, and aspirator for drawing air through the sampling network to the detector; and a flow sensor arranged to detect air flow in an airflow path of the aspirated smoke detector system; said method comprising:

ascertaining the base flow of fluid through a particle detector using a flow sensor of said aspirated smoke detector system~~, said aspirated smoke detector system comprising a sampling network including one or more sampling holes, an aspirator for drawing sir through the sampling network to the detector; and the flow sensor~~ according to the method of claim 27;

monitoring subsequent flow through the particle detector using the flow sensor according to the method of claim 27;

comparing the subsequent flow with the base flow, and determining that one or more sampling holes of the sampling network are blocked and indicating a fault, if the difference between the base flow and the subsequent flow exceeds a predetermined threshold.

30-31. (canceled).

32. (previously presented): The method of claim 29, wherein the difference between base flow and subsequent flow is compared over a length of time.

33. (cancelled).

34. (currently amended): An aspirated smoke detector comprising:

a particle detector,

a sampling network including one or more sampling points; and

an aspirator for drawing air through the sampling network to the detector,

an inlet,

an outlet; and

an ultrasonic flow sensor in fluid communication with the particle detector arranged to detect the flow rate of air entering the particle detector according to the method of claim 27.

35. (previously presented): The detector of claim 34 wherein the flow sensor is in fluid communication with the sampling network and is operationally arranged to measure the partial flow of fluid through a sampling network.

36. (previously presented): The smoke detector of claim 34, wherein the particle detector detects particles in a portion of the air flow flowing through the sampling network.

37. (previously presented): The smoke detector of claim 34 wherein the flow sensor is located in the sampling network.

38. (previously presented): The smoke detector of claim 34, wherein the flow sensor is located in a housing for the particle detector.

39. (previously presented): The smoke detector of claim 34, having a branch in the inlet allowing air to bypass the particle detector.

40. (canceled).

41. (currently amended A non-transitory computer readable recording medium having embodied thereon a computer program for executing the method according to~~A computer program product comprising:~~

~~a computer usable medium having computer readable program code and computer readable system code embodied on said medium for determining the time of flight of a signal transmitted between a transmitter and a receiver within a data processing system, said computer program product comprising:~~

~~computer readable code within said computer usable medium for performing the method steps of~~ claim 1.

42. (currently amended): <u>A non-transitory computer readable recording medium having embodied thereon a computer program for executing the method according to</u> ~~A computer program product comprising:~~

~~a computer usable medium having computer readable program code and computer readable system code embodied on said medium for monitoring flow through a particle detector of an aspirated smoke detector system within a data processing system, said computer program product comprising:~~

~~computer readable code within said computer usable medium for performing the method steps of~~ claim 27.

43. (currently amended): <u>A non-transitory computer readable recording medium having embodied thereon a computer program for executing the method according to</u> ~~A computer program product comprising:~~

~~a computer usable medium having computer readable program code and computer readable system code embodied on said medium for detecting one or more blocked sampling holes in a pipe of an aspirated smoke detector system within a data processing system, said computer program product comprising:~~

~~computer readable code within said computer usable medium for performing the method steps of~~ claim 29.

44- 46. (canceled).

47. (new): A method of monitoring flow through a particle detector of an aspirated smoke detector system, the aspirated smoke detector system including a flow path along which air is drawn, and a flow sensor including a first and second transducers arranged to detect flow in the flow path, the method comprising the steps of:

ascertaining the base flow of fluid through a particle detector using a flow sensor, using a method as claimed in claim 27;

monitoring subsequent flow through the particle detector using a method as claimed in claim 27;

comparing the subsequent flow with the base flow, and indicating a fault if the difference between the base flow and the subsequent flow exceeds a predetermined threshold.